p. 222, gave a note about this latter very rare, nearly forgotten, and often misunderstood little rodent, figured by Alfred Duvaucel in F. Cuvier's great work, the "Histoire Naturelle des Mammiferes." Cuvier could give no indication of its size, nor of its native country, guessing that "qu'il est originaire des provinces du Nord de Bengale, si ce n'est des parties occidentales de Sumatra." Dr. S. Müller, in 1834, obtained a specimen in Java, to the northern side of Mount Gede, and named the species. This, and another specimen from Sumatra (also collected by Müller) are both in the Leyden Museum as stuffed specimens. The skulls of these two specimens were detected in the Leyden Museum by Oldfield Thomas, and were included by Jentink in his catalogue of 1887, though with a query. But all doubt on the subject was removed at the date of this paper; and now the animal has been taken alive by Mr. J. D. Pasteur on the northern slope of the Goenong Gedeh, Java, an account of which capture is given in a very graphic translation of a letter to Dr. Jentink. On birds there are papers by J. Büttikofer on the specimens of the genus Tatare in the Museum, on the specific value of Levaillant's "Traquet Commandeur," and on the collections of birds sent by the late A. T. Demery from the Sulymah river, West Africa, pp. 13–30. In this last paper 96 species are recorded, ten of which are new to Liberia; on *Batrachostomus poliolophus*, n. sp. from W. Sumatra, by Ernst Hartert; on a weaver finch from Sumatra; and on a collection of birds from the islands of Flores, Sumba, and Rotti, by J. Büttikofer; and on the birds of Sumba, by A. B. Meyer. About fish there is a note by Dr. Th. W. van Lidth de Jeude on *Orthragoriscus nasus*, Ranzani, which had been washed ashore in November, 1891, at Callantsoog. A figure from a photograph is given.—M. Schepman describes a number of land and fresh water mollusca from Soemba, Timor, and other East Indian islands; several new species are diagnosed.—Dr. J. G. de Man continues his Carcinological studies in the Leyden Museum, and in No. 6 describes several new species which are figured. A very important contribution to our knowledge of the echinoderms is made by Dr. Clemens Hartlaub's paper on the species and structure of the hard parts in Culcita; nine species are carefully described, their geographical distribution is given, *Culcita grex*, M.T., is figured from a photograph, and a fairly complete bibliography is appended. The rest of the papers are descriptions of new forms of insects.

No. 1 of vol. xv., dated as January, 1893, but published October 30 last, contains a review of the genus Rhipidura, with an enumeration of the specimens in the Leyden Museum. A key to the 75 species now known is given—five are described for the first time. M. E. Buchner has a note on the occurrence of *Mellivora indica*, Kerr, in the Trans-Caspian district; on two supposed new species of Pentadactylus, by M. Schepman. There are also several papers on new forms of insects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 26.—"On the Three-Bar Motion of Watt." By William Brennand. Communicated by C. B. Clarke, F.R.S.

"Further Researches in Connection with the Metallurgy of Bismuth." By Edward Matthey, F.S.A., F.C.S., Assoc. Roy. Sch. Mines. Communicated by Sir G. G. Stokes, Bart., F.R.S.

Paper IV.—"Bismuth, its Separation from Arsenic."—In melting large quantities of bismuth containing arsenic it was found that the surface of the metal being exposed to the air arsenical fumes appeared, and that as the temperature of the metal was raised the arsenic came off in dense white fumes (As_2O_3). An alloy of bismuth containing 0·65 per cent. of arsenic was carefully operated upon and freed from the whole of its arsenical contents, the temperatures being noted at which the separation takes place. When raised to a temperature of 513°C. and maintained at this for a short period, the bismuth was found to be absolutely free from arsenic.

Paper V. "Bismuth, its Separation from Antimony."—Whilst engaged in fusing some 400 or 500 kilogrammes of bismuth containing antimony it was noticed that a peculiar oily film formed on the surface of the alloy, which on being removed and tested was found to contain a considerable percentage of antimony. By continuing the operation and removing the film from time to time as it formed, the melted metal became bright, and was then found to be perfectly free from antimony. A quantity of about 350 kilogrammes of bismuth containing 0·80 per cent. of antimony was melted and the temperature observed at which the antimony separated as described. By maintaining a constant temperature of 458° C. the whole of the antimony separated, leaving the bismuth free from any trace of this metal. The temperatures were determined by the pyrometer of M. H. le Chatelier.

Physical Society, January 13.—Prof. G. F. Fitzgerald, F.R.S., President, in the chair.—Mr. F. W. Sanderson read a paper on science teaching. In this communication the author considers the methods of teaching physical science, and remarks that other sciences may best be treated in some different manner. The method recommended is one found suitable in public schools where boys may remain till about the age of nineteen. In elementary and secondary schools modification would be necessary with a view to making it more immediately useful, whilst in university and technical colleges other methods might be preferable. The object of his public school method was to make physical science a definite means of education, rather than to produce skilled physicists. Certain mathematical subjects, such as arithmetic, geometry, and algebra, should be taught before physics is begun, and taught in such a way as to aid subsequent physical work. In teaching arithmetic it is deemed desirable to distinguish between the science and the art of it, and to have separate hours for instruction in each. The subjects included in each part are described in some detail in the paper. No existing arithmetic satisfies the author's requirements. Geometry is considered of the first importance; practical geometry and the use of instruments forming the best introduction to the subject. It is recommended that the elementary part be taught by the mathematical master with a view to formal geometry, *e.g.* Euclid. As most practical geometries consist of isolated constructions they are useless for teaching the subject in a scientific manner. A number of problems suitable for a graduated introductory course are given. After elementary geometry, mensuration may be taken up with advantage, the facts being verified by drawing to scale, measuring, or by weighing, but no rules being given. Trigonometry of one angle may then be commenced. Here also free use should be made of the drawing board, each pupil finding the sines, cosines, and tangents of angles by drawing and measurement, and making tables. Quite independent of the mathematical class the author has been in the habit of carrying boys on the engineering side through a course of graphical analytical geometry, in which they draw straight lines and the quadratic curves, &c., from their equations, solve simultaneous linear equations, quadratics, cubics, &c. Other geometrical constructions follow. The subject as to what branches of science should be taught in the different departments of a school is then considered, and schemes are given for the classical, modern and commercial, science, and engineering sides. Some general principles which have been kept in view in arranging the physical teaching are next described. In the first place the fundamental experiments and observations on which each scientific law is based are explained to the pupils, and when possible the experiments are performed by the boys in the laboratory. Secondly, from the experiments the laws are stated as precisely as possible, the form of statement depending on the knowledge possessed by the class. The problem of expressing a law mathematically from its most fundamental statement is then fully considered. Thirdly, mathematical deductions from the laws are followed out, and the pupils perform experiments to verify the results, and thus confirm the laws. Fourthly, a course of exact physical measurements is given, which includes mensuration, hydrostatics, mechanics, sound, heat, electricity, and light. A first and second year's course is arranged in each subject, and in both years all the boys work the same experiment at the same time. This necessitates multiplication of apparatus, but being of a simple character in the lower forms where the pupils are numerous it is not prohibitive. It is also stated that boys get better results with comparatively rough apparatus, if large, than with delicate and expensive instruments. About half the time devoted to physics is spent in the laboratory. Mathematics is introduced, as far as can be done without straining the pupils too much, and with young classes appeal is made to experiment where the strictly logical argument would be difficult to follow. Instead of teaching the applications of science as done in some technical schools, the author's method is to teach pure science, and let the applications come in as illustrations. At the end of the paper detailed lists of experiments for practical courses in electricity and optics are given. Samples of the apparatus used were exhibited at the meeting, those for optics being particularly simple and ingenious.—Prof. A. M. Worthington said his experience led him to a very hearty agreement with Mr. Sanderson on all essential points, and he thought there was now a close agreement amongst teachers as to the best methods. He therefore wished to ask, Had not the time now come at which the Physical Society might usefully endeavour to exert direct influence on science teaching? As the scientific instruction of a person who intends following a scientific calling is generally divided into stages, and conducted in different places under different teachers, he thought it was desirable that those in charge of his training at each stage should say up to what point his instruction should be carried before he reaches them. Other matters in which the society might do useful work were (1) reporting on text-books and condemning the bad ones, and (2) furthering the adoption of the decimal system. At present, he said, an enormous extension in the teaching of physical science is taking place, and it seemed within the power of the Physical Society to place itself at the head of the movement. Another point which required to be settled was the relative importance of physics and chemistry at different stages of a student's education.—Mr. L. Cumming agreed with the general principles laid down by Mr. Sanderson. In attempting to carry out such schemes numerous difficulties presented themselves, especially where the science master had not control over the subdivision of the boys' time. He had tried teaching the science of arithmetic to boys in the lower forms, but the results were not encouraging, for he found very few who could do much in it. They seemed to devote themselves much more readily to concrete problems and the art of manipulation of rules. Graphical statics was very valuable. As regards experimental lectures, he believed them to be very important, especially in junior classes. For scholarship boys a different method had been tried with success. Instead of performing lengthy experiments completely before the class, the essential parts were gone over, and for the minor points the results obtained in experiments made before or after the lecture were given, so that all the data for reducing the results were to hand. This saved considerable time. He had hoped Mr. Sanderson would say something about the slide rule, and wished to learn his opinions on its use.—Dr. Stoney said he was very much struck with the methods of teaching brought forward by Mr. Sanderson, and remarked that his own work would have been considerably lightened if such a scheme had been developed many years ago. Experimental methods were very valuable, provided the inaccuracies of measurement be kept in view. Plotting curves was also very instructive, and might be made a means of furnishing the fundamental notions in the differential and integral calculus. As to the introduction of chemistry, his experience went to show that this should be done at an early age. Dynamics should also be begun early.—Mr. W. B. Croft thought that if the Society did make rules to regulate the teaching of physical science, these rules should not be too strict, for the ages and aims of boys might differ widely. At Winchester the science teaching was carried out on the lines recommended by a committee of the Royal Society appointed to consider the subject. (Leaflets showing the scheme adopted were here distributed to members.) The object of the scheme was not merely to make science a means of education, but an integral part of the education of the pupils. He also made a point of keeping the lecture experiments up to date.—Mr. Rentoul said dynamics should not be taught as a mathematical subject, but experimentally. He thought it of the first importance that boys should learn how to find out facts for themselves, and for this practical work was essential.—Prof. Ayrton remarked that the conditions under which science was taught differed in different places. He himself taught with the object of enabling the persons under instruction to improve the industry. For this purpose he believed the analytical method more suitable than the synthetical one advocated by Mr. Sanderson. It also had the advantage of being more scientific, for it was more natural, being, in fact, that used by children from birth, for they had no other means of learning the nature and properties of their surroundings. In his first year's technical course the work was synthetical, whilst in the third year the students, having analysed existing apparatus, were taught to devise new or improved forms, and hence the work became more synthetical.—Mr. F. J. Smith said it was important that students be taught to measure by the balance, micrometer, spherometer, and as soon as possible. He also inquired how far Mr. Sanderson's pupils could help themselves in making the apparatus required for the simple experiments.—Dr. Gladstone agreed with many points in the paper. Lately he had had to do with schemes for improving the teaching in elementary schools. Children were naturally philosophers, but at present their curiosity was considered objectionable and sternly repressed. Efforts were now being made to alter this state of things. Kindergarten classes in infant schools were a step in the right direction. It was very difficult to introduce analogous methods in the higher standards, but natural science had now obtained a footing. Although the methods of teaching adopted might be those suitable for pure science, care should be taken to put in practical illustrations, for when suitably chosen they are sources of great interest to children.—Mr. Sanderson, in reply, said the slide rule was used throughout the course. Mechanics was taught by actual machines, such as pulley blocks, screw jacks, &c. The boys made some apparatus, but to make all would require too much time.—The President, when proposing a vote of thanks to the author of the paper, said that in Ireland the opinion that boys and girls cannot be taught science greatly predominated. They found considerable difficulty in getting any continuation of the kindergarten teaching sanctioned. Possibly drawing might be allowed, but this seemed all they could hope for at present. He wished to emphasise the fact that in such schools the object was education, and practical applications of science were not important except in so far as it created an interest in the subjects. At present scientific teaching was in an experimental stage, and as in other things, progress is made by trial and error. Many different methods were being tried, and it was important to know which were successful and which failures. He thought the Physical Society might be useful in collecting information on the subject by issuing a circular of questions to science teachers, and subsequently drawing up a report on the subject.

Royal Microscopical Society, December 21.—Dr. R. Braithwaite, President, in the chair.—After the formal business necessary to be done at the meeting preceding the annual meeting, the Society adjourned as a mark of respect to the lately deceased Sir Richard Owen, K.C.B., the first president of the Society.

January 18.—Dr. R. Braithwaite, President, in the chair.—This being the annual meeting the President gave an address on the development of mosses and sphagnums, illustrating his subject with drawings and slides under microscopes in the room.—On the Rev. Canon Carr proposing, and Mr. W. T. Suffolk seconding, a hearty vote of thanks was given to the President for his interesting address.—The annual report and the treasurer's statement of accounts having been read and adopted, the following were elected as officers and council for the ensuing year:—President: Mr. A. D. Michael; Vice-Presidents: Dr. R. Braithwaite, Mr. F. Crisp, Mr. James Glaisher, and Prof. Charles Stewart; Treasurer: Mr. W. T. Suffolk; Secretaries: Prof. F. Jeffrey Bell, Dr. W. H. Dallinger; Ordinary Members: Dr. Lionel S. Beale, Mr. A. W. Bennett, Rev. Canon Carr, Mr. E. Dadswell, Mr. C. Haughton Gill, Dr. R. G. Hebb, Mr. G. C. Karop, Mr. E. M. Nelson, Mr. T. H. Powell, Prof. Urban Pritchard, Mr. F. H. Ward, and Mr. T. Charters White.

Oxford.

University Junior Scientific Club, February 1.—The President in the chair.—At the conclusion of private business Mr. J. E. Marsh gave an exhibit of some products of the electric furnace. He had brought for the inspection of the club some specimens, from M. Moissan's laboratory, of fused lime and uranium reduced from the oxide. He explained the construction of the furnace, and the methods of using it and of obtaining the temperature of the arc. He further commented on M. Berthelot's views as to the limit of temperature of the furnace, pointing out that the maximum value was that of the temperature of vaporisation of carbon, and that in all cases this was obtained. After a short discussion Mr. F. Finn, who has just returned from Africa on a worm-hunting expedition, described the incidents of his journey. His remarks were illustrated by a number of lantern slides showing scenes on the coast, chiefly at Mombasa and Zanzibar. His first stay was at Lamu, where he did not get any worms, the natives misunderstanding his signs and bringing bones. He described his impressions of Zanzibar at some length, being agreeably surprised at the place. Near here he obtained several reptiles and birds which are now in the Zoological Gardens. His chief collection was made at Mombasa, however. He speaks very highly of the hospitality of the Europeans on that coast.—Mr. F. G. Fremantle read a paper on Hermaphroditism, confining his attention to human beings. He divided his subject into various classes, ranging from complete, or almost complete, neutrality of sex, to those cases where either male or female characteristics preponderated, concluding with some cases of pure deception. The paper was illustrated with diagrams, and a large number of cases were cited in support of the statements made. He showed that a perfect hermaphrodite both physiologically and anatomically could not exist, either the male or female characters preponderating in every case. After a short discussion the club adjourned until February 17.

Cambridge.

Philosophical Society, January 30.—Prof. T. McK. Hughes, President, in the Chair.—Mr. Bateson exhibited a dog's skull, lent by Mr. J. Harrison of Northampton, in which the upper canines were bigeminous, each having two crowns both in the plane of the arcade.—The following communications were made:—On a new fern from the coal measures, by Mr. A. C. Seward. The specimen described as a new species, *Rachiopteris Williamsoni*, resembles in certain particulars the genus *Myeloxylon*, but possesses distinctive characters not previously recognised in fossil fern petioles. *Rachiopteris Williamsoni* may be briefly described as a petiole with scattered vascular bundles; those near the periphery appear to be rather collateral than concentric in structure, but the larger bundles have a more decided concentric arrangement of the xylem and phloem. Each group of xylem elements is surrounded by a ring of small secretory canals. The hypoderm is like that of *Myeloxylon*, and gum (?) canals are abundantly distributed in the ground tissue. On the intestinal movements of *Daphnia*, by Mr. W. B. Hardy. — On Urobilin, by A. Eichholz, Emmanuel College. In this communication a new method of urobilin extraction was described, by which the pigment is preserved in the state of chromogen. The properties of urobilin in normal and febrile urines were recapitulated in order to compare urobilin with the reduction products from bilirubin and hæmatin. The communication was then devoted to a description of experiments devised to settle the question as to the possibility of artificial production of urobilin from bilirubin and hæmatin. After pointing out how Maly's hydrobilirubin differs from true urobilin, and how consequently the identity of Hoppe Seyler's and Neucki and Sieber's urobilin from hæmatin reduction becomes doubtful, it was shown, in spite of statements to the contrary by McMunn and Le Nobel, that it is possible by complete reduction of both bilirubin and hæmatin to obtain substances in each case accurately resembling urobilin.

Paris.

Academy of Sciences, January 30.—M. de Lacaze-Duthiers in the chair.—On some objects made of copper of a very ancient date, discovered in the course of M. Sarzec's excavations in Chaldæa, by M. Berthelot. M. de Sarzec has unearthed some relics of the most ancient Chaldæan civilisation, which confirm M. Berthelot's views as to the existence of an age during which pure copper was used instead of bronze, the latter being introduced after the rise of the commerce in tin. A fragment of a small votive figure, found among the foundations of an edifice more ancient than that of the King Our-Nina, was assayed for copper and chlorine by means of nitric acid. It contained neither silver, bismuth, tin, antimony, zinc, nor magnesium; only traces of lead, arsenic, and sulphur, and 77·7 per cent. of copper, the bulk of the rest consisting of alkaline earthy carbonates and silica. Its composition resembles that of the statuette of the Chaldæan King Goudeah, and also that of the sceptre of the Egyptian King Pepi I., of the sixth dynasty, showing that in those early times tin was not known in the two most ancient homes of civilisation.—On the diurnal variations of gravitation, by M. Mascart. A barometric tube enclosing a column of mercury 4·5m. in length, balanced by the pressure of hydrogen contained in a lateral vessel, has been kept surrounded by earth for several years at the Parc Saint-Maur Observatory, only the short upper end emerging from the ground. A study of the daily motions of the column by means of photographic registration has recently, apart from the slow and steady changes due to inevitable differences of temperature, shown sudden variations lasting from 15 to 60 minutes, which can hardly be explained otherwise than as due to corresponding variations in gravitation. They have been as high as 1/20 mm., or 1/90000. The differences of sea-level from high to low water would only produce 1/5th of this variation. The phenomena, if due to subterranean displacements, would be specially interesting in volcanic districts.—On solar statistics for the year 1892, by M. Rod. Wolf.—On the pathogenic properties of the soluble substances formed by the microbe of contagious bovine peripneumonia, and their value for the diagnosis of the chronic forms of this disease, by M. S. Arloing.—The H and K lines in the spectrum of the solar faculæ, by Mr. George E. Hale.—On the differential equations of a higher order, the integral of which only admits of a given number of determinations, by M. Paul Painlevé.—On ordinary linear differential equations, by M. Jules Cels.—On the systems of linear differential equations of the first order, by M. Helge von Koch.—On the theory of spherical functions, by M. E. Beltrami.—Decomposition of alkaline aluminates in presence of aluminium, by M. A. Ditte.—Electrometric study of acid triplatohexanitrite of potassium, by M. M. Vèzes.—Action of water vapour upon perchloride of iron, by M. G. Rousseau.—On two combinations of cuprous cyanide with alkaline cyanides, by M. E. Fleurent.—On the composition of some hydrated alkaline phenates, by M. de Forcrand.—Researches on the acid salts and the constitution of the colouring matters in the rosaniline group, by M. A. Rosenstiehl.—Analysis of medicinal creosotes; gayacol, by MM. A. Béhal and E. Choay.—On an apparatus for the quantitative determination of precipitates by an optical method, by M. E. Aglot.—On the pre-existence of gluten in wheat, by M. Balland.—The evolution of the intestinal gregarinas of the marine worms, by M. Louis Léger.—Origin and multiplication of Ephestia Kuehniella (Zeller) in the mills of France.—On the perithecæ of *Uncinula spiralis* in France and the identity of the American and European *Oidium*, by M. G. Couderc.—Histological researches on the *Uredinei*, by MM. P. A. Dangeard and Sapin-Trouffy.—New geological observations in the French Alps, by M. W. Kilian.

CONTENTS.

PAGE
The Milky Way. By **A. T.** 337
The Theory of Substitutions and its Applications to Algebra. By **G. Ch.** 338
The Brain in Mudfishes 339

Our Book Shelf:—

Lea: "The Chemical Basis of the Animal Body."—**W. D. H.** 340
"Chambers's Encyclopædia" 340
Hutton: "Arthur Young's Tour in Ireland (1776-79)" 341

Letters to the Editor:—

Some Lake Basins in France.—**Prof. T. G. Bonney, F.R.S.** 341
Dust Photographs.—**W. T. Thiselton-Dyer, F.R.S.; F. J. Allen** 341
Fossil Plants as Tests of Climate.—**Chas. E. De Rance** 342
Lunar Rainbow in the Highlands.—**O. S. B.** . . . 342
Optical Continuity. (*With Diagrams.*) By **Francis Galton, F.R.S.** 342
British New Guinea. (*Illustrated.*) By **Henry O. Forbes** 345
Notes 347

Our Astronomical Column:—

Comet Holmes (1892 III.) 351
Comet Brooks (November 19, 1892) 352
Spectra of Planetary Nebulæ and Nova Aurigæ . . . 352
Sun-spots and Magnetic Perturbations in 1892 . . . 352
New Minor Planets 352
The Lunar Surface 352
Geographical Notes 352
The Institution of Mechanical Engineers 353
The Seven Images of the Human Eye. By **E. E. F. d'A.** 354
A Botanist's Vacation in the Hawaiian Islands. By **Prof. D. H. Campbell** 355
Instruments for the Earthquake Laboratory at the Chicago Exposition. By **Prof. John Milne, F.R.S.; F. Omori** 356
University and Educational Intelligence 357
Scientific Serials 357
Societies and Academies 358